Chapter 4

A Visualization and Clustering Approach to Analyzing the Early Warning Signals of Currency Crises

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ABSTRACT

In this chapter, the authors investigate the use of advanced machine learning and data analysis methods for analyzing the early warning signals of currency crisis. So far the empirical studies on economic crises have focused on conventional economic modeling methods. Their study aims to see if new insights can be gained from the application of other methods, more specifically neural network based clustering analysis methods such as the SOM (Self-Organizing Maps), in analyzing important economic indicators for the prediction of financial crises. The authors shall first give a review of studies on crisis early warning systems, introduce the SOM method, then present and discuss the results from analyzing the 1992 Finnish currency crisis using the SOM.

INTRODUCTION

Financial crises are not uncommon and their consequences are often severe, thus they constitute an important and interesting field of economics research. In the 1990s alone, four waves of financial crises occurred around the world: the European ERM crisis in 1992-1993 – which also hit a number of non-ERM currencies like the Finnish markka, the Mexican Peso crisis in 1994-1995, the Asian crisis

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of 1997-1998 and the Russian crisis in 1998, soon after which a financial crisis broke out in Argentina in 2002. At the moment of writing this book, the world economy is undergoing great turbulence. In fact, we are witnessing one of the most severe and widely spread economic crises in history in the US and many other parts of the world.

The repeated occurrence of financial crises has stimulated a large number of theoretical and empirical studies on the phenomena, in particular studies on the determinants and early warning signals of financial crises (Chowdhry and Goyal, 2000). However, the results from the large number of studies have so far been mixed. Although the relevant macroeconomic variables or indicators of a financial crisis are commonly known, crises still tend to take market participants by surprise, even with the support of existing instruments for systematic monitoring, analysis and interpretation of economic variables, as is shown in various existing studies. Much remains to be explored to further improve the early warning instruments for financial crises.

So far the empirical studies on economic crisis have largely focused on conventional economic modeling methods. In this chapter, we will focus on investigating the use of advanced machine learning and data analysis methods for analyzing the early warning signals of a currency crisis. In our earlier study (Liu and Lindholm, 2006), we have applied fuzzy c-means (FCM) clustering methods to the analysis of the Finnish macroeconomic fundamentals around the period of the Finnish currency crisis in 1992. The assumption of our study was that cluster analysis of the economic fundamentals covering both the crisis and non-crisis time period could help us to understand the gradual changes in the behavior of the economic indicators in different time periods, to learn their characteristics at different points in time, and then lead us to the possible identification of critical levels for those fundamental imbalances. Our primary results gave us some interesting insights into the possible usefulness of the method. In this study, we extend our earlier research by looking into the application of the self-organizing map (SOM) to economic crisis analysis. The SOM is a neural network based clustering method with unique data visualization capabilities. Multi-dimensional data can be projected onto a two-dimensional map, and thus may be able to provide an overall picture of what is implied in a complex data set. The SOM map is easy to update continuously, making it superior to many other graphical representations of multidimensional data. The SOM thus seems to be an attractive alternative method for analyzing the macroeconomic fundamentals time series data, where it is important that the nature of change can be visualized on the map as a slow shift toward the crisis zone even if the changes could not be predicted by traditional methods.

In the following, we will first provide the relevant background knowledge on economic crisis in general and currency crisis in particular. This will give the theoretical and empirical knowledge about macroeconomic stability and financial crises, the nature, characteristics and impacts of crises, as well as the state of the art in the research field. The Finnish currency crisis of 1992 will be introduced.

We will then describe the SOM method, familiarize readers with its rationale and mathematical foundation. We will also provide readers with knowledge of the various applications of the SOM for analyzing different economics problems, as well as the use of other methods for analyzing crisis early warning signals.

Following the above introductions of basic theory, methods and research issue, we will present our own study on using the SOM for analyzing the early warning signals of financial crises. This will include the description of the data, data collection and parameter tuning, as well as reporting of the experiment results.

In-depth analysis and interpretation of the experiment results will be given in light of economic theories and existing empirical studies. We will also discuss the key issues with applying the SOM
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